2012-04-30

A quantitative risk analysis of deficient contractor business system

Fast, William

Monterey, California. Naval Postgraduate School

NPS-AM-12-C9P13R02-070

EXCERPT FROM THE

PROCEEDINGS

OF THE

NINTH ANNUAL ACQUISITION RESEARCH SYMPOSIUM WEDNESDAY SESSIONS VOLUME I

A Quantitative Risk Analysis of Deficient Contractor Business System

William Fast
Naval Postgraduate School

Published April 30, 2012

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 APR 2012		**00-00-2012 to 00-00-2012**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
A Quantitative Risk Analysis of Deficient Contractor Business System	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Postgraduate School,Monterey,CA,93943**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
This research reviews quantitative risk models to determine how to best portray the risk to the government of deficient contractor business systems. One model, operational value at risk (VaR) is proposed as the model for use by a government contracting officer when justifying the withholding of contractor payments for a ?significant deficiency? in the contractor?s earned value management (EVM) system (per DFARS 252.234.7005, effective August 16, 2011).

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**34**	

The research presented at the symposium was supported by the acquisition chair of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

To request defense acquisition research or to become a research sponsor, please contact:

NPS Acquisition Research Program
Attn: James B. Greene, RADM, USN, (Ret.)
Acquisition Chair
Graduate School of Business and Public Policy
Naval Postgraduate School
Monterey, CA 93943-5103
Tel: (831) 656-2092
Fax: (831) 656-2253
E-mail: jbgreene@nps.edu

Copies of the Acquisition Research Program's sponsored research reports may be printed from our website (www.acquisitionresearch.net).

ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL

Preface & Acknowledgements

Welcome to our Ninth Annual Acquisition Research Symposium! This event is the highlight of the year for the Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) because it showcases the findings of recently completed research projects—and that research activity has been prolific! Since the ARP's founding in 2003, over 800 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at www.acquisitionresearch.net, at a rate of roughly 140 reports per year. This activity has engaged researchers at over 60 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a "broker" to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and hope this symposium will spark even more participation.

We encourage you to be active participants at the symposium. Indeed, active participation has been the hallmark of previous symposia. We purposely limit attendance to 350 people to encourage just that. In addition, this forum is unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. Seldom will you get the opportunity to interact with so many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. In the words of one senior government official, "I would not miss this symposium for the world as it is the best forum I've found for catching up on acquisition issues and learning from the great presenters."

We expect affordability to be a major focus at this year's event. It is a central tenet of the DoD's Better Buying Power initiatives, and budget projections indicate it will continue to be important as the nation works its way out of the recession. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you're a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:

- Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)
- Director, Acquisition Career Management, ASN (RD&A)
- Program Executive Officer, SHIPS
- Commander, Naval Sea Systems Command
- Program Executive Officer, Integrated Warfare Systems
- Army Contracting Command, U.S. Army Materiel Command
- Office of the Assistant Secretary of the Air Force (Acquisition)

- Office of the Assistant Secretary of the Army (Acquisition, Logistics, & Technology)
- Deputy Director, Acquisition Career Management, U.S. Army
- Office of Procurement and Assistance Management Headquarters, Department of Energy
- Director, Defense Security Cooperation Agency
- Deputy Assistant Secretary of the Navy, Research, Development, Test & Evaluation
- Program Executive Officer, Tactical Aircraft
- Director, Office of Small Business Programs, Department of the Navy
- Director, Office of Acquisition Resources and Analysis (ARA)
- Deputy Assistant Secretary of the Navy, Acquisition & Procurement
- Director of Open Architecture, DASN (RDT&E)
- Program Executive Officer, Littoral Combat Ships

We also thank the Naval Postgraduate School Foundation and acknowledge its generous contributions in support of this symposium.

James B. Greene Jr.
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD
Associate Professor

Panel 13. Risk and Reward in Defense Contracting

Wednesday, May 16, 2012	
3:30 p.m. – 5:00 p.m.	**Chair: The Honorable Brian Miller,** Inspector General, U.S. General Services Administration ***The Excessive Profits of Defense Contractors: Evidence and Determinants*** Chong Wang and Joseph San Miguel *Naval Postgraduate School* ***Fixed-Price Development Contracts: A Historical Perspective*** William Lucyshyn, Jacques S. Gansler, and Jiahaun Lu *University of Maryland* ***A Quantitative Risk Analysis of Deficient Contractor Business System*** William Fast, *Naval Postgraduate School*

Brian Miller—The U.S. Senate confirmed Brian D. Miller as the Inspector General of the U.S. General Services Administration on July 22, 2005.

As Inspector General, Miller leads more than 300 auditors, special agents, lawyers, and support staff in conducting nationwide audits and investigations. As a national leader in the fight against procurement fraud, Miller participates in the U.S. Attorney General's Financial Fraud Enforcement Task Force and partners with federal, state, and local officials to share information to detect, investigate, and prevent procurement, Recovery Act, and grant fraud. Miller is a frequent speaker at conferences, task force meetings, and regional working groups, and he testifies regularly before Congress.

Before becoming Inspector General, Miller worked for the U.S. Department of Justice for 15 years, beginning in the Office of Policy Development. Attorney General Janet Reno appointed him as an assistant U.S. attorney for the Eastern District of Virginia, where he concentrated on procurement, grant, and health care fraud cases. In 2001, he served as the senior counsel to the deputy attorney general and special counsel for health care fraud for the U.S. Department of Justice. In 2002, he returned to the U.S. Attorney's Office to serve as counsel to the United States attorney, while continuing grand jury, trial, and appellate responsibilities as an assistant U.S. attorney.

Miller strives to provide aggressive, strategic, and creative leadership by developing new ways to fight fraud. In 2010, he established the Government Infrastructure Protection Initiative within his Office of Investigations to protect the federal procurement process and supply chain from the dangers associated with counterfeit products. In this effort, he partnered with the National Intellectual Property Rights Coordination Center. In 2008, he created a forensic auditing unit and sponsored federal forums to promote forensic auditing as a tool to analyze databases and to detect fraud. In 2006, Miller was named vice chair of the National Procurement Fraud Task Force, a task force of the Department of Justice, law enforcement offices, and several inspectors general. As co-chair of the Legislation Committee, he played a key role in amending the Federal Acquisition Regulation to require contractors to report overpayments and crimes. He was also a principal author of a legislative and regulatory reform white paper, which resulted in legislation, regulation, and a national debate on issues related to procurement fraud.

Miller has received notable recognition for his service as Inspector General. He was recognized by *Ethisphere Magazine* as the 12th "most influential person in business ethics" by a worldwide panel of experts. He was named among "Those Who Dared: 30 Officials Who Stood Up for Our Country," a

special report of Citizens for Responsibility and Ethics in Washington, a national advocacy organization. Miller also received the Attorney General's Award for Distinguished Service.

Miller has a Juris Doctor from the University of Texas.

Quantitative Risk Analysis of Deficient Contractor Business Systems

William Fast—COL Fast, USA (Ret.), facilitates acquisition and program management courses at the Naval Postgraduate School. He also writes and speaks on various management topics and provides consultation services to defense acquisition programs. From 2006–2010 COL Fast taught program and financial management courses at the Defense Acquisition University. [wrfast@nps.edu]

Abstract

This research reviews quantitative risk models to determine how to best portray the risk to the government of deficient contractor business systems. One model, operational value at risk (VaR) is proposed as the model for use by a government contracting officer when justifying the withholding of contractor payments for a "significant deficiency" in the contractor's earned value management (EVM) system (per DFARS 252.234.7005, effective August 16, 2011).

Research Issue

The director of the Earned Value Management Division of the Defense Contract Management Agency (DCMA) asked for assistance in developing a method that administrative contracting officers (ACO) can use to assess risk associated with non-compliant contractor business systems. A recent rule change in the Defense Supplement to the Federal Acquisition Regulation (DFARS, 2011) permits an ACO to withhold up to 10% of contract payments for a "significant deficiency" in a contractor's business system that creates risk to the government. The research issue is how to objectively and quantitatively portray that risk in a way that supports a monetary withhold decision and can withstand push-back (to include litigation) from the defense contractor.

Background

Patterned after the Truman Committee of the World War II era, the Commission on Wartime Contracting in Iraq and Afghanistan cited numerous deficiencies in business systems used by companies executing contracts in support of those wars (Commission on Wartime Contracting, 2009). As a result of the commission's hearing before the Congress in August 2009, Senate Bill 3454 was introduced and ultimately found its way into the Ike Skelton National Defense Authorization Act (NDAA) for FY 2011, directing that

> the Secretary of Defense develop and initiate a program for the improvement of contractor business systems to ensure that such systems provide timely, reliable information for the management of Department of Defense programs by the contractor and by the Department. (NDAA for FY2011, § 893)

The legislation was precise in defining a "contractor business system" and a "covered contract" but only loosely defined a "significant deficiency" (see Table 1).

Table 1. Definition of Terms, Contractor Business Systems
(NDAA for FY2011, § 893)

Term	Definition
Contractor Business System	• accounting system • estimating system • purchasing System • earned value management system • material management and accounting system • property management system
Covered Contractor	A contractor that is subject to the cost accounting standards under section 26 of the Office of Federal Procurement Policy Act (41 U.S.C. 422)
Covered Contract[1]	• cost-reimbursement contract • incentive-type contract • time-and-materials contract • labor-hour contract
Significant Deficiency	"…shortcoming in the system that materially affects the ability of officials of the Department of Defense and the contractor to rely upon information produced by the system that is needed for management purposes."

Acting on the 2009 Interim Report of the Commission on Wartime Contracting, the Department of Defense, Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics), published a draft rule on contractor business systems in January 2010. This first attempt at a contracting rule tried to explain what constitutes an acceptable business system and the percent of payments that would be withheld for deficiencies in single or multiple business systems. In response, the Department received 370 comments from 25 respondents (Brodsky, 2010).

Another draft of the proposed rule was issued for comment in December 2010. This draft clarified how Department officials would determine when contractor business systems are deficient, and it lowered from 20% to 10% the amount of payments that the Department could withhold from contractors when deficiencies go uncorrected (Brodsky, 2010). Respondent comments to the December 2010 draft rule for contractor business systems ranged over 34 different topic areas. Some of the more significant objections to this draft rule were the following:

- The rule fails to offer any guidance to the contracting officer for describing a "significant deficiency."
- There is the potential for inconsistent application of business system criteria when determining a "significant deficiency."
- The Defense Contract Management Agency (DCMA) and the Defense Contract Audit Agency (DCAA) are under-resourced to implement the rule.

By May 18, 2011, an interim rule, with comments from interested respondents, was published in the Federal Register (DFARS, 2011, Case 2009-D038, pp. 28856–28879). The interim rule took effect on contracts awarded on or after August 16, 2011.

[1] "The [interim] rule [dated May 18, 2011] has been tailored to comply with section 893 of the FY11 NDAA. DoD has interpreted the definition of 'covered contract' to include CAS-covered cost type contracts as well as CAS-covered fixed-price contracts and performance-based contracts since section 893 also allows up to 10 percent of progress payments and performance-based payments to be withheld" (Federal Register, 2011, p. 28862).

In addition, the DCMA has developed an implementation procedure to guide its administrative contracting officers who will be enforcing the rule (Contractor Business Systems, Instruction Folder Number 301 to the DCMA [2012a] Guidebook).

To date, only one contractor has had payments withheld under the new rule. Starting in March 2012, 2% of payments to Lockheed Martin Corporation's aeronautics division were withheld due to deficiencies in its earned value management system (EVM system). The withholds total about $1million per month from billings on Lockheed's latest production contract for 30 F-35 fighters. The total contract value is about $4 billion (Cappacio, 2012). If the EVM system deficiencies remain uncorrected through the entire period of performance of the contract, the total withhold could be about $80 million.

The DCMA decertified Lockheed's aeronautics division EVM system in October 2010, about 10 months before the business systems rule went into effect. At that time, the DCMA had determined that 19 of 32 EVM system guidelines were not being followed (see Appendix A for the 32 EVM system guidelines). Owing to the fact that Lockheed has made corrections and improvements to its EVM system since that time, the Pentagon payment withholdings were set at 2% rather than the 5% maximum permitted by law for a significant deficiency in a single business system (Cappacio, 2012).

Literature Review

Galway (2004) presents a critical review of the use of quantitative risk analysis in system development projects like those managed by the Department of Defense. He concludes that quantitative risk analysis can be a valuable tool; however, it is not well understood by project managers, not well integrated into project management, and hard to explain to senior decision-makers. He found few empirical examples attesting to the usefulness of quantitative risk analysis in complex development projects (Galway, 2004, p. 19).

Qualitative Risk Analysis Prevails Within DoD

Galway's observations track with current Department of Defense acquisition policy and guidance. Quantitative assessment of risk consequences are mentioned only once in the *Risk Management Guide for DoD Acquisition* (USD[AT&L], 2006, p. 33). In the current version of the *Defense Acquisition Guidebook*, the phrase "quantitative risk analysis" is used only three times (all uses pertain to cost estimating), and there are no practical examples provided to explain the analysis method to the reader (DoD, 2012, pp. 138, 158).

However, Galway (2004) does bring insight to the challenge of quantifying business system risks by suggesting that all risks should be mapped to cost, schedule, and performance by asking these questions: 1) How much will the project finally cost?; 2) How long will the project eventually take?; and 3) Will this product perform according to specifications? (Galway, 2004, p. ix). Moreover, his approach agrees with the cost, schedule, and performance categorization of risk found in the *Risk Management Guide for DoD Acquisition* (USD[AT&L], 2006, pp. 13–16).

From Qualitative to Quantitative Risk Analysis Using Existing DoD Guidance

Could the current *Risk Management Guide for DoD Acquisition* be revised to include more quantitative risk analysis? The answer is yes. During risk assessment, the guide requires the analysis of future root causes of risk as to probability of occurrence and severity or consequence if that future root cause is realized. Simply multiplying the probability of a risk event (expressed as a decimal) by a monetized severity of loss would yield a monetary risk number. Adding up all of those monetary risk numbers for all elements of an acquisition program would provide an informative, albeit somewhat simplified quantitative risk

assessment. There are more sophisticated approaches to quantifying risk that could be applied to risk due to deficient contractor business systems. These methods include expected value of information (EVI) decision theory and value at risk (VaR) methods, both of which consider probability distributions.

Expected Value of Information (EVI)

One government response to public comments related to the risk of harm and materiality of deficiencies in the December 2010 draft business systems rule was stated as follows: "In most cases, the financial impact of a system deficiency cannot be quantified because the system produces unreliable information" (Federal Register, 2011, p. 28859). Hubbard (2007) would challenge that statement. Hubbard maintains that understanding quantitative risk is the key to understanding how to value information (or, by implication, partial information or unreliable information).

Using decision theory, Hubbard explains an approach for measuring the expected value of information (Hubbard, 2007, chapter 7). His basic equation is as follows:

$$EVI = EOL\ (before\ information) - EOL\ (after\ information) \quad (1)$$

where,

$$EVI = Expected\ Value\ of\ Information$$
$$EOL = Expected\ Opportunity\ Loss = Chance\ of\ being\ wrong\ \times\ Cost\ of\ being\ wrong$$

(Hubbard, 2007, p. 88)

Hubbard (2007) contends that EOL exists because of uncertainty that clouds the negative consequences of our decisions. By acquiring more information, uncertainty will be reduced and, in turn, the EOL will be reduced. Moreover, the Expected Value of Perfect Information (EVPI) can be determined when uncertainty is eliminated (Hubbard, 2007, pp. 89–89).

Hubbard (2007) contends that EOL exists because of uncertainty that clouds the negative consequences of our decisions. By acquiring more information, uncertainty will be reduced and, in turn, the EOL will be reduced. Moreover, the Expected Value of Perfect Information (EVPI) can be determined when uncertainty is eliminated (Hubbard, 2007, pp. 89–89).

This approach might be useful for the government contracting officer. EVPI might be calculated for each of the six contractor business system, assuming that the information provided is flawless so that the decisions made from that information are never wrong. The sum of each of the six business system EVPIs would represent the total dollar value to the government of a particular contractor's business systems.

Value at Risk (VaR)

Jorion (2007) has written one of the most comprehensive texts on how banks and other financial institutions use value at risk (VaR) to quantify potential investment losses. He defines VaR as "the worst loss over a target horizon such that there is a low, prespecified probability that the actual loss will be larger" (Jorion, 2007, p. 106). Knowing the VaR with a high degree of confidence tells the firm how much cash and capital reserves are necessary to cover the risk. Mathematically, Jorion's concept of VaR looks like this:

$$P(L > VaR) \leq 1 - c \quad (2)$$

where,

$$P = Probability$$

$$L = Loss, measured\ as\ a\ positive\ number$$
$$VaR = Value\ at\ Risk, reported\ as\ a\ positive\ number$$
$$c = confidence\ level, expressed\ as\ a\ decimal\ (e.g.,.99)$$

(Jorion, 2007, p.106)

Jorion's approach to quantifying downside risk has five steps: (1) Determine the current value of the portfolio (mark position to market); (2) Measure the variability of the various risk factors, such as changes in interest rates, fluctuations in foreign exchange rates, and volatility in commodity and equity prices; (3) Since volatility grows with the square root of time, set the time horizon, based on the trading days over which the assets will be held; (4) Select the desired confidence level; and (5) calculate the potential loss (Jorion, 2007, p. 107). In its simplest form, VaR can be expressed as follows:

$$VaR = Current\ Market\ Value\ (\$) \times \sigma \times \sqrt{t/252} \times \alpha \quad (3)$$

where,

$$\sigma = measured\ variability\ of\ risk\ factors, expressed\ as\ a\ percentage$$
$$t = trading\ days; 252 = trading\ days\ in\ a\ year$$
$$\alpha = confidence\ level, expressed\ as\ a\ factor\ (e.g., assuming\ 99\%\ confidence\ and\ a\ normal\ distribution, the\ factor\ would\ be\ 2.33)$$

From this basic VaR equation, Jorion (2007) presents three models for calculating VaR. The *local-valuation method* determines the value of a portfolio once and uses mathematical derivatives, both linear and quadratic, to measure exposures to the variability of risk (σ) (Jorion, pp. 249–251). The *full-valuation method* reprices a financial portfolio over a range of risk scenarios, using tools such as Monte Carlo simulation (Jorion, 2007, pp. 251–257). And, the *historical simulation method* is a nonparametric approach that "replays" the tape of history on the current market value of a portfolio (Jorion, 2007, pp. 262–263).

Hendricks (1996) has evaluated these three methods of calculating VaR using historical financial market data. He concludes that all of these methods cover the risks they are intended to cover and that the risk estimates do not differ much in average size. Substantial differences between the methods are seen when comparing methods for one trading date; however, less variation is seen over longer periods (Hendricks, 1996, pp.55–56). Hendricks' method of validating VaR methods using historical market data is also instructive for this research into the risk analysis of deficient business system. Unless the quantitative risk methods can be verified as covering the government's risks and unless those methods can be used by the contracting officer, they are of little use.

Kaufman and Sougstad (2007) use VaR in a slightly different manner. They use VaR as a constraint function to help make better decisions on risks associated within a portfolio of information technology (IT) service contracts. They consider the risk levels of various mixes of these IT contracts (high, medium, and low) and maximize an objective function for profitability, subject to the VaR constraint. This approach might be useful for the government contracting officer when selecting a portfolio of services contractors within a military contingency operation, while keeping the overall program within a predetermined VaR to the government.

Operational Value at Risk (VaR)

Jorion (2007) devotes an entire chapter to *Operational Risk Management*, an approach to quantifying risk using methods from the insurance industry and from VaR. In the financial sector, operational risk is rooted in fraud and poor governance. Realized operational risks come in two varieties. *High-frequency/low-value risks* occur mainly from

daily transaction errors and poorly implemented internal controls that do not catch these errors. Data on these relatively small but frequent losses is easy to collect, provided that the losses are reported. On the other hand, *low-frequency/high-value risks* are the big losses that ultimately bankrupt an institution. Examples include the corporate lies that resulted in the Enron scandal in 2001 and the more recent subprime mortgage crisis that led to the bankruptcy of Lehman Brothers in 2008. When combined, the continuous distribution of the severities of both of these types of risk losses decreases exponentially with the size of the loss. The log-normal, Weibull, and gamma probability distributions are often used to model this type of loss distribution (Jorion, 2007, pp. 501, 511). The gamma distribution is shown in Figure 1.

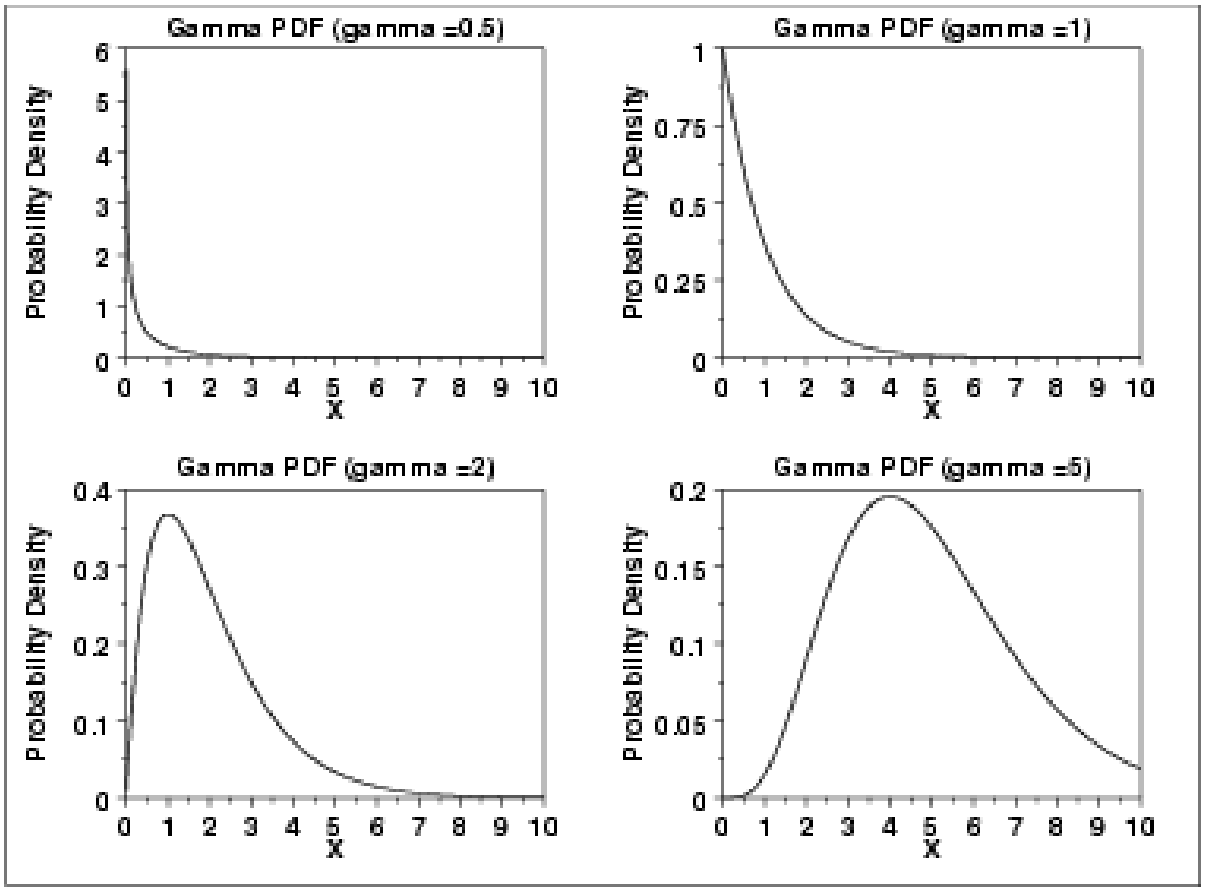


Figure 1. Gamma Distribution
(National Institute of Standards and Technology, 2012)

Jorion (2007, p. 497) measures operational risk using a 4-step approach: (1) Define risk categories such as processes, people, systems, and external events; (2) Measure risk factors in terms of loss frequency; (3) Measure exposure in terms of loss severity; and (4) Calculate risk, either operational VaR or expected loss. The probability distribution function of loss, used in the calculation of either operational VaR or expected loss, is determined using this integral:

$$probability\ distribution\ function\ of\ loss = \int g(s \mid n)\, f(n)\, dn \qquad (4)$$

where,

$g(s \mid n) = probability\ distribution\ function\ of\ the\ sum\ of\ severity\ variables$
$s = loss\ severity$

$$n = loss\ frequency\ (number\ of\ occurences\ of\ loss\ over\ the\ time\ horizon)$$
$$f(n) = probability\ distribution\ function\ of\ the\ loss\ frequency\ (n)$$

From Equation 4, we see that the probability distribution function of the aggregated loss is a combination of the loss frequency and the loss severity probability distributions. Combining the frequency and severity distributions can either be done manually by systematically tabulating all possible combinations (the process is termed *convolution*) or by the integral, as shown in Equation 4 (Jorion, 2007, pp. 498–501).

Research Methodology

This initial research effort addressed only EVM systems, one of the six contractor business systems identified in section 893 of the National Defense Authorization Act for Fiscal Year 2011. Data was extracted from contract performance reports (CPR) in the Defense Cost and Resource Center (DCARC) EVM Central Repository. The repository provides and supports the centralized reporting, collection, and distribution for key acquisition EVM data, such as CPRs, Contract Funds Status Report (CFSR), and the Integrated Master Schedule (IMS) for Acquisition Category 1C & 1D (Major Defense Acquisition Programs) as well as ACAT 1A (Major Automated Information System) programs.

When monthly CPRs are submitted by the defense contractor, government analysts must check to ensure that the data makes sense. If errors are present and remain undetected, the data could result in poor decisions by both the contractor and the government. This is called a validity check of the CPR data and the check ties most directly to the accounting related group of EVM system guidelines (16, 17, 18, 19, 20, 21; a description of the EVM system guidelines is at Appendix A).

The DCARC provides, free of charge to both government and contractor EVMS analysts, CPR file viewer software that includes a tool designed to perform validity checks on the EVM data contained in the CPR. There are a total of 10 validity checks included in the software. These validity checks have been endorsed by the *Government Accountability Office Cost Estimating and Assessment Guide* (GAO-09-3SP; GAO, 2009) and the Society of Cost Estimating and Analysis Cost Estimating Body of Knowledge (SCEA CEBoK).

Two of the validity checks that provide a definitive measure of data validity are as follows: (1) the cumulative Budgeted Cost of Work Performed (BCWP) has value with no corresponding cumulative Actual Cost of Work Performed (ACWP); and (2) cumulative ACWP has value with no corresponding cumulative BCWP. The first validity check indicates that budgeted and authorized work performed in a particular Work Breakdown Structure (WBS) element was recorded in the EVM system, but no labor or material costs were recorded in the company's accounting system for that work. The effect of this error is to understate the actual cost of work that has been performed. The second validity check reveals that actual labor and material costs (ACWP) were recorded against a particular WBS in the accounting system, but no earned value (BCWP) was credited in the EVM system of the company. The effect of this error is to overstate the actual cost of work that has been performed.

Three system development efforts, from three different defense contractors, were selected from the DCARC EVM Central Repository. For each of these systems, three separate monthly CPRs were selected. The two validity checks discussed in this section were performed on each of these nine CPRs.

Results Analysis and Conclusion

Loss distributions were analyzed using Risk Solver Platform by Frontline Systems. In most cases, the loss distributions were best fit by the gamma distribution. Thus, Jorion's (2007) operational VaR method could be used to estimate the risk to the government of deficient information from contractor EVM systems.

Use of the VaR model would benefit the government contracting officer by providing a defensible risk value as the basis for withholding contractor payments.

Recommendations for Further Research

Future research should define a "significant deficiency" in an EVM system and what it means for that significant deficiency to materially affect the ability to rely upon information produced by the EVM system.

Future research should map significant deficiencies to risk of harm to the government (future root causes of risk with probability and consequence). Risk of harm may be outside the contract (e.g., new replacement aircraft carrier will be delivered late, requiring old aircraft carrier to be retained in service with added operating and maintenance costs). Risk of harm may include the value of not having a needed combat capability (i.e., liquidated damages). Moreover, risk of harm may include such things as supply chain and industrial base risks. In addition, future research should take a look at current EVM system metrics that are already collected on a regular basis and focus on the impact (if any) those metrics have on risk of harm.

Future research should include validation of the operational VaR model and the simplification of that model into a template that can be used by contracting officers. Research should also be conducted into changes needed to the DCMA contractor business systems instruction, EVM system compliance review instruction, and EVM system standard surveillance instruction as a result of using operational VaR.

Once the operational VaR method is devised for significant materials deficiencies in EMV systems, apply operational VaR (or another more suitable quantitative method) to the other five business systems covered by DFARS (2011) 252.234.7005, being careful to first define significant deficiency, materially affect, and risks of harm for each of those business systems, separately.

Additional research proposed by the DCMA is found at Appendix B.

References

Brodsky, R. (2010, December 6). Defense revises rule on contractor business systems. Retrieved from Government Executive website: http://www.govexec.com

Capaccio, T. (2012, February 28). Pentagon to withhold Lockheed F-35 payments over tracking. Retrieved from Bloomberg News website: http://bloomberg.com

Commission on Wartime Contracting in Afghanistan and Iraq. (2009, June 10). *At what cost? Contingency contracting in Iraq and Afghanistan* (Interim Report to Congress). Retrieved from http://www.wartimecontracting.gov

Commission on Wartime Contracting in Afghanistan and Iraq. (2009, September 21). *Defense agencies must improve their oversight of contractor business systems to reduce fraud, waste, and abuse* (Special Report 1 on Contractor Business Systems). Retrieved from http://www.wartimecontracting.gov

Commission on Wartime Contracting in Afghanistan and Iraq. (2011, August 31). *Transforming wartime contracting: Controlling costs, reducing risks* (Final Report to Congress). Retrieved from http://www.wartimecontracting.gov

Defense Contract Management Agency (DCMA). (2011, June). Earned value management system (EVMS) compliance review instruction (CRI). Retrieved from DCMA guidebook website: http://guidebook.dcma.mil

Defense Contract Management Agency (DCMA). (2012a, January). Contractor business systems. Retrieved from DCMA guidebook website, instruction folder number 308: http://guidebook.dcma.mil

Defense Contract Management Agency (DCMA). (2012b, February). Earned value management system (EVMS) standard surveillance instruction (SSI). Retrieved from DCMA guidebook website: http://guidebook.dcma.mil

Defense Federal Acquisition Regulation Supplement (DFARS), 48 C.F.R. ch. 2 (2011). Retrieved from http://www.acq.osd.mil/dpap/dars/dfarspgi/current/index.html

DoD. (2012, January 10). *Defense acquisition guidebook*. Retrieved from https://dag.dau.mil

Federal Register. (2011, May 18). *Defense federal acquisition regulation supplement: Business systems—Definition and administration; interim rule, 76*(96), 28858–28879.

Fleming, Q. W., & Koppelmann, J. M. (2005). *Earned value project management* (3rd ed.). Newtown Square, PA: Project Management Institute.

Galway, L. (2004, February). *Quantitative risk analysis for project management: A critical review* (RAND working paper WR-112-RC). Retrieved from http://www.rand.org/pubs/working_papers/2004/RAND_WR112.pdf

GAO. (2009, March). *GAO cost estimating and assessment guide: Best practices for developing and managing capital program costs* (GAO-09-3SP). Retrieved from http://www.gao.gov

Hendricks, D. (1996, April). Evaluation of value-at-risk models using historical data. *FRBNY Economic Policy Review*, 39–69.

Hubbard, D. W. (2007). *How to measure anything: Finding the value of "intangibles" in business*. Hoboken, NJ: Wiley.

Jorion, P. (2007). *Value at risk: The new benchmark for managing financial risk* (3rd ed.). New York, NY: McGraw-Hill.

Kaufman, R., & Sougstad, R. (2007). *Value-at-risk in IT services contracts. In Proceedings of the 40th Hawaii International Conference on System Sciences—2007*. Institute of Electrical and Electronics Engineers.

National Defense Authorization Act for Fiscal Year 2011, § 893 (2011).

National Institute of Standards and Technology. (2012, April). *NIST/SEMATECH e-handbook of statistical methods*. Retrieved from http://www.itl.nist.gov/div898/handbook/

USD(AT&L). (2006, August). *Risk management guide for DoD acquisition*. Washington, DC: Author.

Appendix A. ANSI/EIA-748 Earned Value Management System (EVMS) Guidelines (Fleming & Koppelmann, 2005, pp. 191–214)

ANSI/EIA-748 GUIDELINES
ORGANIZATION
Criterion 1. Define the authorized work elements for the agency. A WBS, tailored for effective internal management control, is commonly used in this process.
Criterion 2. Identify the organizational structure including the major contractors responsible for accomplishing the authorized work, and define the organizational elements in which work will be planned and controlled.
Criterion 3. Provide for the integration of the agency's planning, scheduling, budgeting, work authorization and cost accumulation processes with each other, the WBS, and the OBS.

Criterion 4. Identify the organization or function responsible for controlling overhead (indirect costs).
Criterion 5. Provide for integration of the WBS and the organizational structure in a manner that permits cost and schedule performance measurement by elements of either or both structures as needed.
PLANNING, SCHEDULING, AND BUDGETING
Criterion 6. Schedule the authorized work in a manner that describes the sequence of work and identifies significant task interdependencies required to meet the requirements of the program.
Criterion 7. Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure progress.
Criterion 8. Establish and maintain a time-phased budget baseline, at the control account level, against which performance can be measured. Budget for far-term efforts may be held in higher-level accounts until an appropriate time for allocation at the control account level. Initial budgets established for performance measurement will be based on either internal management goals or the external customer-negotiated target cost including estimates for authorized but undefined work.
Criterion 9. Establish budgets for authorized work with identification of significant cost elements (labor, material, etc.) as needed for internal management and for control of contractors.
Criterion 10. To the extent it is practical to identify the authorized work in discrete work packages, establish budgets for this work in terms of dollars, hours, or other measurable units. Where the entire control account is not subdivided into work packages, identify the far term effort in larger planning packages for budget and scheduling purposes.
Criterion 11. Provide that the sum of all work package budgets plus planning package budgets within a control account equals the control account budget.
Criterion 12. Identify and control level of effort activity by time-phased budgets established for this purpose. Only that effort which is immeasurable or for which measurement is impractical may be classified as level of effort.
Criterion 13. Establish overhead budgets for each significant organizational component of the company for expenses that will become indirect costs. Reflect in the budgets, at the appropriate level, the amounts in overhead pools that are planned to be allocated as indirect costs.
Criterion 14. Identify management reserves and undistributed budget.
Criterion 15. Provide that the allocated budget is reconciled with the sum of all internal budgets and management reserves.
ACCOUNTING
Criterion 16. Record direct costs in a manner consistent with the budgets in a formal system controlled by the general books of account.
Criterion 17. Summarize direct costs from control accounts into the WBS without allocation of a single control account to two or more WBS elements.
Criterion 18. Summarize direct costs from the control accounts into the agency's organizational elements without allocation of a single control account to two or more organizational elements.
Criterion 19. Record all indirect costs that will be allocated to the agency.
Criterion 20. Identify unit costs, equivalent units costs, or lot costs when needed.
Criterion 21. For EVMS, the material accounting system will provide for: • Accurate cost accumulation and assignment of costs to control accounts in a manner consistent with the budgets using recognized, acceptable, costing techniques. • Cost performance measurement at the point in time most suitable for the category of

material involved, but no earlier than the time of progress payments or actual receipt of material. • Full accountability of all material purchased including the residual inventory.
MANAGERIAL ANALYSIS & REPORTING
Criterion 22. At least on a monthly basis, generate the following information at the control account and other levels as necessary for management control using actual cost data from, or reconcilable with, the accounting system: • Comparison of the amount of planned budget and the amount of budget earned for work accomplished. This comparison provides the schedule variance. • Comparison of the amount of the budget earned with the actual (applied where appropriate) direct costs for the same work. This comparison provides the cost variance.
Criterion 23. Identify, at least monthly, the EV Variance between both planned and actual schedule performance and planned and actual cost performance, and provide the reasons for the variances in the detail needed by management.
Criterion 24. Identify budgeted and applied (or actual) indirect costs at the level and frequency needed by management for effective control, along with the reasons for any significant variances.
Criterion 25. Summarize the data elements and associated variances through the organization and/or WBS to support management needs and any customer reporting specified in the contract.
Criterion 26. Implement managerial actions taken as the result of earned value information.
Criterion 27. Develop revised EAC based on performance to date, commitment values for material, and estimates of future conditions. Compare this information with the performance measurement baseline to identify variances at completion important to company management and any applicable customer reporting requirements including statements of funding requirements.
BASELINE MANAGEMENT
Criterion 28. Incorporate authorized changes in a timely manner, recording the effects of such changes in budgets and schedules. In the directed effort prior to negotiation of a change, base such revisions on the amount estimated and budgeted to the organizations.
Criterion 29. Reconcile current budgets to prior budgets in terms of changes to the authorized work and internal replanning in the detail needed by management for effective control.
Criterion 30. Control retroactive changes to records pertaining to work performed that would change previously reported amounts for actual costs, earned value, or budgets. Adjustments should be made only for correction of errors, routine accounting adjustments, effects of customer or management directed changes, or to improve the baseline integrity and accuracy of performance measurement data.
Criterion 31. Prevent revisions to the agency budget except for authorized changes.
Criterion 32. Document changes to the performance measurement baseline.

Appendix B. Proposed Research on Significant Material Deficiency, Prepared by DCMA, March 28, 2012

QUANTITATIVE METHODS FOR ESTIMATING SIGNIFICANT MATERIAL DEFICIENCY

References:

(a) DFARS: Business systems, Interim rule, Federal Register, Vol. 76, No. 96, 18 May 2011.

(b) National Defense Authorization Act for FY 2011, sect. 893, Contractor Business Systems.
(c) ANSI/EIA 748C EVMS Guidelines
(d) DCMA EVMS Compliance Review Instruction
(e) DCMA Contractor Business Systems Instruction

1. BACKGROUND—Statutory and regulatory guidance in references (a) and (b) identify six (6) contractor business systems that may, when providing inaccurate and unreliable data, create a "risk of harm" to the government. When that risk is substantiated and validated by the discovery of *significant deficiencies* in the contractor's business system, reference (a) authorizes the government to withhold payment to the contractor to mitigate the risk. In many cases, the financial impact and materiality of the deficiency is difficult to quantify, since it is the inaccurate and unreliable data produced by the business system that is (in fact) the deficiency. Although six business systems are covered by references (a) and (b), the initial focus on this research is the earned value management system (EVMS). Methods, practices, and guidelines for establishing EVMS deficiencies are fairly mature. Reference (c) guidelines are explicitly cited as "high risk" guidelines (GL: 1,3,6,7,8,9,10,12,16,21,23,26,27,28,30,32). A significant deficiency in any one of these guidelines constitutes EVMS non-compliance. In any case, the standard for withholding payments to the contractor is commensurate with the ($) risk to the government. It is the causal relationship between risk and system deficiency and the calculation of a risk value (in $dollars) that is the core issue. A consistent, repeatable and quantitative method is needed to fairly determine if payment withholds of 5% are necessary to mitigate the government's risk.

2. RESEARCH TOPICS/QUESTIONS—The following research topics are suggested:

a. Similar risk management problems exist in industry, including insurance, banking, and investment portfolio management. In the insurance industry, actuarial data is applied to model risk and risk capital reserves are "held" to cover the expected values for claims. In banking, the banks hold cash reserves to maintain liquidity and cover the expected values of depositor withdrawals, based on regulatory requirements for capital (risk) reserves. In investment portfolios, managers evaluate value at risk across the portfolio and adjust holdings as necessary to maintain the risk value below acceptable levels. In all three of these examples, the scenario manages risk in an environment that is characterized by probabilistic behavior, expected ($) values and risk management objectives that are governed by regulation and statutory law. Research questions are as follows:

i. Can any of these risk management models (or others) be extrapolated to the business system rule implementation?
ii. What quantitative methods can be developed to quantify material financial risk to government when a business system produces "unreliable and inaccurate data"?
iii. How do other regulatory activities manage risk that is caused by business system deficiencies?

b. EVMS are "critical guidelines" (cited above). When a significant deficiency exists in one of these guidelines the EVMS is non-compliant and will be disapproved by the administrative contracting officer (ACO). A significant deficiency in a non-high risk guideline may result in disapproval at the discretion of the ACO. The following research questions, specific to EVMS apply:

i. Is there any rank or natural order to the potential severity of the deficiency posed by these guidelines? To what degree is there inter-dependence or

causality across these guidelines? Can they be group or “binned” WRT causality of risk?

ii. What quantitative method(s) can be used to calculate risk value WRT non-compliance of critical guidelines, or non-critical guidelines?

iii. What quantitative definition of “significant deficiency” is applicable?

iv. Is it possible to develop a deterministic rule set that yields a consistent and repeatable finding of significant deficiency?

v. What should be the relationship of risk value calculations and findings of EVMS (GL) non-compliance with

a. Probability of error,

b. Magnitude of errors, and

c. Adverse impact of errors

c. Other business systems are also within the scope of references (a) and (b); the following questions apply:

i. Can an extensible method be developed for all business systems WRT the calculation of risk value?

ii. What is the standard of compliance that applies to the non-EVMS business systems? Do these standards have clearly defined “compliance” criteria?

d. Instead of “measuring” business system compliance with various guidelines and standards, is there a better approach to risk management, when there is potential harm to the government?

ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL
555 DYER ROAD, INGERSOLL HALL
MONTEREY, CA 93943

www.acquisitionresearch.net

Quantitative Risk Analysis of Deficient Contractor Business Systems

William R. Fast
Senior Lecturer
Graduate School of Business and Public Policy
Naval Postgraduate School
Ingersoll Hall, Room 219
555 Dyer Road
Monterey, CA 93943

wrfast@nps.edu
Office: 831-656-3628
Fax: 831-656-3407

Research Issue

- Request from Director of the Earned Value Management Division of the Defense Contract Management Agency (DCMA)
- Asked for assistance in developing a method that Administrative Contracting Officers (ACO) can use to assess risk associated with non-compliant contractor business systems
- A recent rule change in the Defense Supplement to the Federal Acquisition Regulation (DFARS) permits an ACO to withhold up to 10% of contract payments for a “significant deficiency” in a contractor’s business system that creates risk to the government.
- The research issue is how to objectively and quantitatively portray that risk in a way that supports a monetary withhold decision and can withstand push-back (to include litigation) from the defense contractor.

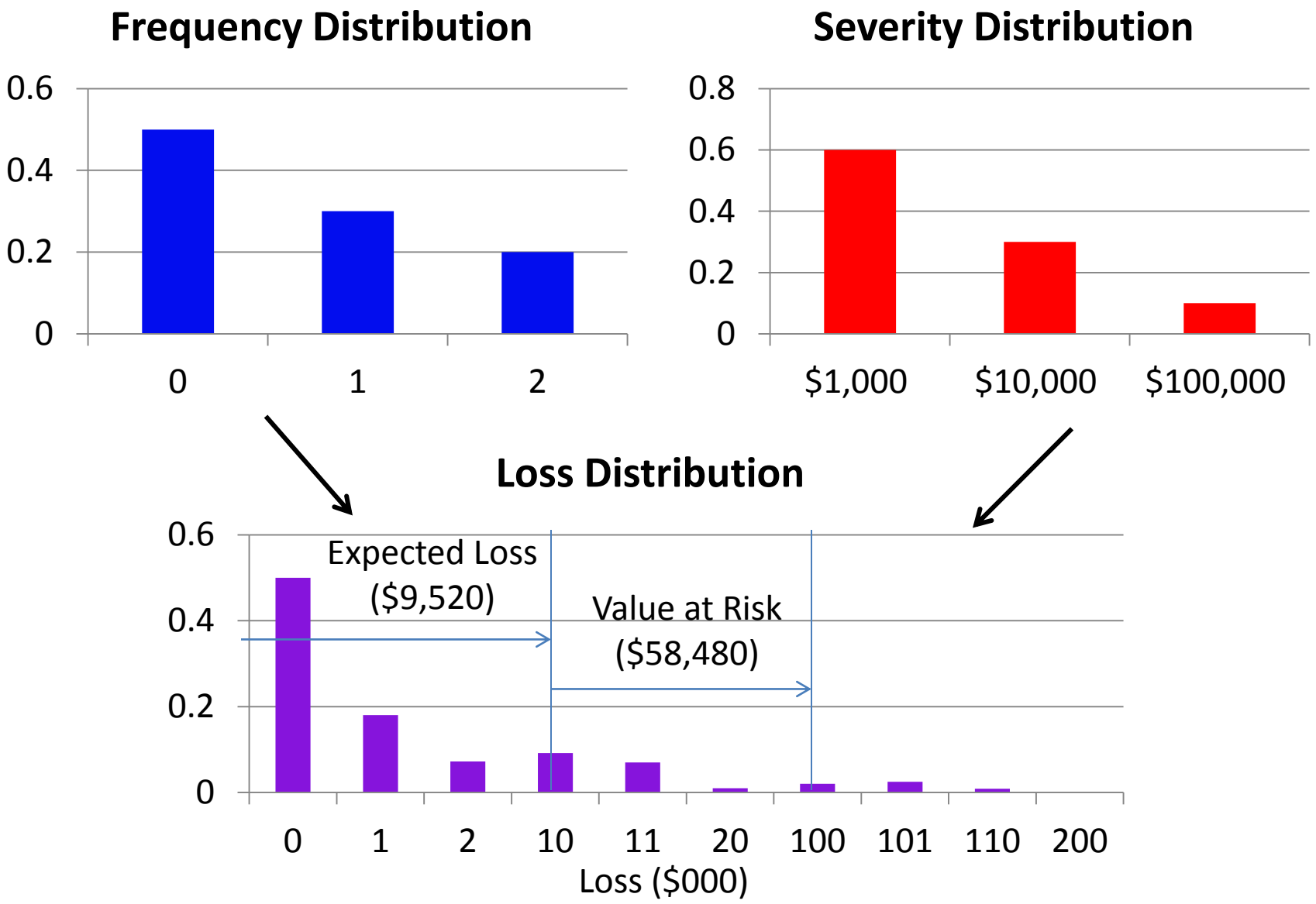
Definition of Terms
Contractor Business Systems
Section 893, NDAA for FY2011

Term	Definition
Contractor Business System	• accounting system • estimating system • purchasing system • earned value management system • material management and accounting system • property management system
Covered Contractor	A contractor that is subject to the cost accounting standards under section 26 of the Office of Federal Procurement Policy Act (41 U.S.C. 422)
Covered Contract	• cost-reimbursement contract • incentive-type contract • time-and-materials contract • labor-hour contract
Significant Deficiency	"…shortcoming in the system that materially affects the ability of officials of the Department of Defense and the contractor to rely upon information produced by the system that is needed for management purposes."

Feedback on December 2010 Draft Rule

- The rule fails to offer any guidance to the contracting officer for describing a “significant deficiency.”
- There is the potential for inconsistent application of business system criteria when determining a “significant deficiency.”
- The Defense Contract Management Agency (DCMA) and the Defense Contract Audit Agency (DCAA) are under-resourced to implement the rule.

Constructing the Loss Distribution*



*Notional, see Jorion (2007), Value at Risk, Chapter 19, Operational Risk

Earned Value Management
32 Guidelines

1. Define the Project Work Scope
2. Define the Project Organization
3. Integrate Subsidiary Processes
4. Identify Overhead Management
5. Integrate WBS/OBS to Create Control Accounts
6. Schedule with network logic
7. Set measurement indicators
8. Establish the CBB/PMB
9. Budget by cost elements
10. Create work/planning packages
11. Sum WP/PP budgets to the Control Account
12. Level of Effort planning
13. Set overhead budgets
14. Identify Management Reserve and Undistributed Budget
15. Reconcile CBB to target values

Accounting Processes

16. ***Record direct costs***
17. Summarize direct costs by WBS elements
18. Summarize direct costs by OBS elements
19. Record/allocate indirect costs
20. Identify unit and lot costs as needed
21. Track and report material costs/quantities
22. Calculate Schedule Variance & Cost Variance
23. Identify significant variances for analysis
24. Analyze indirect Cost Variance
25. Summarize information for management
26. Implement corrective actions
27. Revise Estimate At Completion
28. Incorporate changes in a timely manner
29. Reconcile current to prior budgets
30. Control retroactive changes
31. Prevent unauthorized revisions
32. Document PMB changes

Source: Defense Acquisition University, BCF-262 Card EVMS Guidelines

Contract Performance Report Validity Checks

		GAO Cost Estimating and Assessment Guide*	Definitive Measure?
Sanity Checks (Anomalies)	negative values for ACWP, BAC, BCWP, BCWS, or EAC		Y
	unusually large performance swings (BCWP) from month to month		N
	BCWP and BCWS data with no corresponding ACWP		Y
	BCWP with no BCWS		Y
	BCWP with no ACWP		Y
	ACWP with no BCWP	p. 257	Y
	Inconsistency between EAC and BAC, such as no BAC but an EAC and vice versa		Y
	BCWP or BCWS exceeds BAC		Y
	ACWP that is way above or below the planned value		N
	ACWP exceeds EAC		Y

*Similar definitive sanity checks are found in the SCEA CEBoK, p. 57

Source: CPR File Viewer Users Guide, Version 1.0.2.20, p. 30

Two Validity Checks Selected

BCWP with no ACWP

- Indicates that budgeted and authorized work performed in a particular Work Breakdown Structure (WBS) element was recorded in EVM system, but no labor or material costs were recorded in company's accounting system for that work.

- The effect of this error is to understate the actual cost of work that has been performed.

ACWP with no BCWP

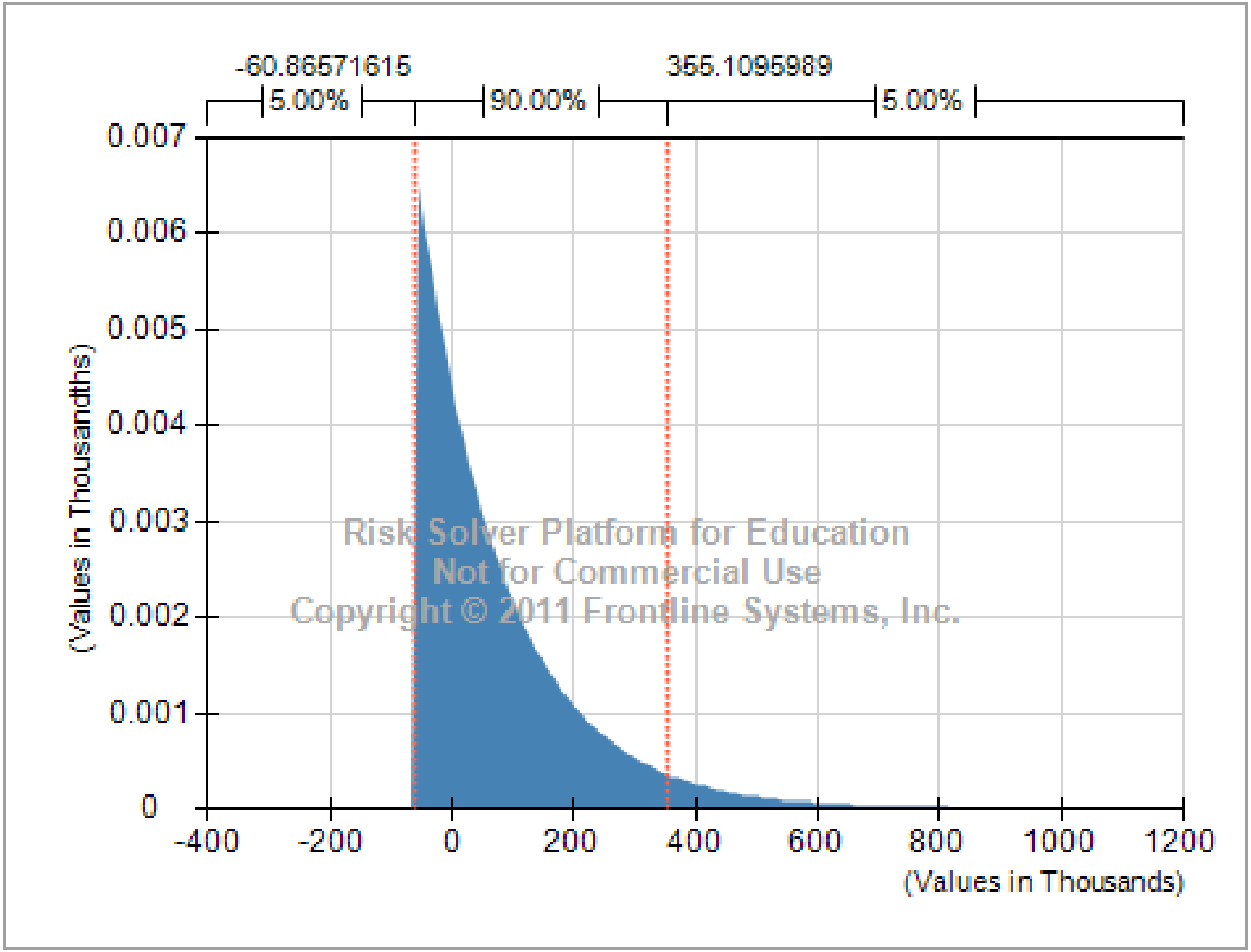
- Reveals that actual labor and material costs (ACWP) were recorded against a particular WBS in the accounting system, but no earned value (BCWP) was credited in the EVM system of the company.

- The effect of this error is to overstate the actual cost of work that has been performed.

Research Results

Program	CPR Date	BCWP w/no ACWP	Dollar Value of Errors	% of WBS elements w/errors	ACWP w/no BCWP	Dollar Value of Errors	% of WBS elements w/errors	Number of WBS Elements
1	Feb-12	6	47443	0.01	13	2359780	0.02	719
1	Nov-11	7	80043	0.01	10	25000	0.01	719
1	Aug-11	9	114269	0.01	10	33269	0.01	716
2	Feb-12	30	175295	0.01	324	5722147	0.15	2216
2	Dec-11	40	272495	0.02	242	6004275	0.12	2012
2	Aug-11	24	445108	0.01	217	15931175	0.13	1635
3	Jan-12	82	1228323	0.10	30	58140	0.04	820
3	Oct-11	84	1363864	0.11	22	90663	0.03	779
3	Jul-11	49	1086391	0.07	11	35545	0.02	710

Research Results



Gamma Loss Distribution, Program 2, CPR Aug 11, ACWP with no BCWP

Research Conclusions

- Distributions were best fit by Exponential (2), Gamma (4), Weibull (5), and LogLogistics (6) loss distributions.
- An Operational Value at Risk (VaR) method (Jorion, 2007) could be used to estimate the risk to the government of deficient information from contractor EVM systems.
- Use of the VaR model would benefit the government contracting officer by providing a more defensible risk value as the basis for withholding contractor payments.

Future Research

Research Topic 1

Similar risk management problems exist in industry, including: insurance, banking, and investment portfolio management. In the insurance industry, actuarial data is applied to model risk and risk capital reserves are maintained to cover the expected values for claims. Banks hold cash reserves to maintain liquidity and cover the expected values of depositor withdrawals, based on regulatory requirements for capital (risk) reserves. Investment portfolio managers evaluate value at risk across the portfolio and adjust holdings as necessary to maintain the risk value below acceptable levels. In all three of these examples the risk environment is characterized by probabilistic behavior, expected dollar values, and risk management objectives that are governed by regulation and statutory law.

- Can any of these risk management models (or others) be extrapolated to the business system rule implementation?
- What quantitative methods can be developed to quantify material financial risk to government when a business system produces “unreliable and inaccurate data”?
- How do other regulatory activities mange risk that is caused by business system deficiencies?

Future Research

Research Topic 2

Under ANSI/EIA-748, Earned Value Management Systems (EVMS) must comply with 32 guidelines. When a significant deficiency exists in one of the critical guidelines the EVMS is non-compliant and will be disapproved by the Administrative Contracting Officer. The following research questions apply specifically to EVMS:

- Is there any rank or natural order to the potential severity of the deficiency posed by these guidelines? To what degree is there inter-dependence or causality across these guidelines? Can they be group with respect to causality of risk?
- What quantitative method(s) can be used to calculate risk value with respect to non-compliance of critical guidelines, or non-critical guidelines?
- What quantitative definition of “significant deficiency” is applicable?
- Is it possible to develop a deterministic a rule set that yields a consistent and repeatable finding of significant deficiency?
- What should be the relationship of risk value calculations and findings of EVMS non-compliance, with: 1) probability of error; 2) magnitude of errors; and, 3) adverse impact of errors?

Future Research

Research Topic 3

Other business systems (accounting, estimating, material management and accounting, purchasing, and property management) are also within the scope of the contractor business system rule and the following questions apply:

- What is the standard of compliance that applies to the non-EVMS business systems? Do these standards have clearly defined compliance criteria?
- Can an extensible method be developed for all business systems with respect to the calculation of risk value?

Research Topic 4

Instead of measuring business system compliance with various guidelines and standards, is there a better approach to risk management, when there is potential harm to the government?